Automatic Calibration

Calibration of the WSR-88D is required for 2 purposes: verifying system accuracy and monitoring system performance. The first purpose is used for ensuring our system puts out dBZ within 1dB and our velocities and spectrum widths are within 1 m/s (calibration). The second purpose is for maintenance: identifying problems (setting alarms) and incipient faults (monitoring). The System Specification drives many of these tasks and gives us required values and tests.

Table 1

Calibration/Check	Operate	Standby	OLOP	Performance Check
Noise Level	Yes	Yes	Yes	
Noise Temperature	Yes	Yes	Yes	
Linearity	Yes	Yes	Yes	
Dynamic Range	Yes	Yes	Yes	Yes
Spectrum Width and Velocity	No	No	Yes	Yes
Transmitter Power	Yes		Yes	Yes
Power Meter Zero	Yes	Yes	Yes	Yes
Full Linearity			Yes	Yes
KD Check (Klystron Delayed)			Yes	Yes
Clutter Suppression			Yes	Yes
RFD Check (RF Drive)			Yes	Yes

- Operate
  - These calibrations and checks are done during Antenna retrace
  - The Transmitter power check is an exception, it is done during the Volume Coverage Pattern (VCP) while the transmitter is radiating
- Standby
  - These calibrations and checks are done approximately every 2 minutes in Standby
- OLOP (Off-Line Operate)
  - These calibrations and checks are done approximately every 2 minutes in OLOP
  - This causes the transmitter to radiate into dummy load
- Performance Check
  - These checks are done every 8 hours in operation and Standby
  - Spectrum Width and Velocity tests are moved to only the Performance Check. A waiver to the SS will be submitted (by us), and a CCR to the SS will be done (by whoever does those).

The Outputs and expected values of these tests are:

Table 2

Test Derived From	Value	Ideal Output	Units	Notes
Linearity	Linear Fit	0	dB	Deviation from best fit, Standard Deviation of Least Squares Linear Curve Fit
	Clutter Suppression	50	dB	Difference between unfiltered and filtered
	KD	0	dB	Delta between expected and measured
	KD Injection	0	dB	Delta between KD injected in Front End and Cabinet
Noise Level	Short Pulse and/or Long Pulse Channel	0.237 e – 07 (est)	Watts	Estimated from removal of IF and analog components. Depends on

	Noise			System Noise Figure and SIGMET's numerical scale
Noise Temperature	Noise Temperature	520 (est)	Kelvin	10 - 20 less than legacy on average, assuming only change to noise figure is removal of IF/Analog components
Linearity	Linear Slope	1.00		Slope of receiver transfer curve
Linearity & Noise Level	I_0	-108	dBm	based on Dale and Bill's Digital Receiver Paper, this value is an intermediate value used in the calculation of dBZ_0, and represents the power level where signal=noise
Linearity	SYSCAL (dBZ_0)	-48	dBZ	Extrapolated from legacy SYSCAL – Noise-Gain Difference
Linearity	Delta SYSCAL (ΔdBZ_0)	0	dB	Because our system will be perfect…
Dynamic Range	Dynamic Range	94	dB	Expected based on 14 bit A/D, our matched filter selection, and our noise figure. 94dB has been measured on the SIGMET IFD.
Spectrum Width & Velocity	Spectrum Width	0	m/s	Deviation from a known injected Spectrum Width
Spectrum Width & Velocity	Velocity	0	m/s	Deviation from a known injected Velocity
Transmitter Power	Transmitter Power	700	kW	Peak Power, calculated from the measured average power
Power Meter Zero	Transmitter Meter Zero	10		Bolometer bias with transmitter off, needed to keep power meter in linear range

The system has 4 receiver built-in-test (BIT) signals available. The signals we'll be using for each test are:

Table 3

Test Signal	Tests
CW	Linearity, Dynamic Range, Spectrum Width/Velocity, full Linearity
Noise	Noise Temperature
RF Drive	RFD Check
Klystron Delayed	KD Check, Clutter Suppression

Noise (add variables and alarms for Long Pulse Noise)

- Purpose
  - Measure the noise floor of the system to use in the Radar Equation for calculating dBZ
- Description
  - The transmitter is turned off, and with the antenna above 3.5° (to avoid ground noise), the receiver measures power. This is the system noise floor (mostly from thermal noise). This value is smoothed to prevent normal noise variations from causing large noise changes.
  - The algorithm used is the same as Legacy, using a different number of data points.
- Alarms
  - If the noise level is out of range (determined by Adaptation Data), the following alarms are reported:
    - LIN CHAN NOISE LEVEL DEGRADED (short pulse)
- Conditions
  - Elevation greater than 3.5° (prefer above 5°)

  - Clutter filter off
  - Point clutter filtering off
  - Interference suppression off
  - Transmitter off
  - No test signals injected
  - Test attenuator set to maximum attenuation (103dB)
  - Front end injection point
  - Matched filter set to pulse width in use
- Parameters
  - Table needs to be added

Table 4

Parameter	Number	Type	Description
$Noise_{OLD}$		P	The previous noise value, used in smoothing the receiver noise value
$Noise_{current}$			Noise value measured
Pulse_Width		P	Short or Long matched filter used
N_s			Number of samples used to compute noise. Needs to be large enough to eliminate any problems with variance
Noise		P	Smoothed noise value put into performance data (used by next calibration as "Old_Noise"
N_Smooth	R219	A	Smoothing coefficient, used as a low pass IIR filter to make noise values less responsive to noise spikes
NoiseScale(El)	R24-R36	A	The noise floor correction based on elevation (El). This accounts for ground noise at lower elevations. Above 5° this is 1.00 (no correction).
Receiver Noise Lin Channel Lower Limit	R222	A	
Receiver Noise Lin Channel Upper Limit	R223	A	

Table 4 Legend: P – Performance Data
A – Adaptation Data

- Algorithm
  - For Pulse_Width=1 to 2 /* Short Pulse and Long Pulse*/
    - N_s = 512 /* Number of Samples*/
    - Store start elevation El_{start}
    - For i=1 to N_s /* gather 512 data points*/
      - Record I and Q values from receiver
    - Store stop elevation El_{stop}
    - $$El = \frac{(El_{start} + El_{stop})}{2}$$
    - look up NoiseScale(El) from adaptation data /* blue sky correction for elevation */
    - $$I\_Power = \frac{\left(\sum_{n=1}^{N_s} I^2\right)}{N_s}$$
    - $$Q\_Power = \frac{\left(\sum_{n=1}^{N_s} Q^2\right)}{N_s}$$

- $Noise_{Current} = (I\_Power + Q\_Power) / NoiseScale(El)$
- Get Old_Noise from Performance Data
- If Old_Noise == 0
  - $Noise_{OLD} = Noise_{Current}$ /* In case the previous Noise Value was deleted */
- $Noise = (1 - N\_smooth) * Noise_{OLD} + N\_smooth * Noise_{Current}$ /* N_smooth is the smoothing coefficient from Adaptation Data */
- Update Performance data with Noise
- If NOISE<LIN_LOW or NOISE>LIN_HIGH
  - Set alarm LIN CHAN NOISE LEVEL DEGRADED

Noise Temperature

- Purpose
  - This test computes the Noise Temperature of the system using an internal calibrated noise source. This test primarily evaluates receiver sensitivity and is not used in calculations of R,V, or W.
- Description
  - Using the calculated $Noise_{current}$ from the Noise calibration as $Noise_{OFF}$, we measure the noise with the Noise Source on. The Ratio of $Noise_{ON}$ to $Noise_{OFF}$ gives us the Noise Temperature in degrees Kelvin (based on a reference room temperature of 290K).
  - The algorithm used is the same as Legacy, using a different number of data points.
- Alarms
  - These thresholds will be adjusted based on actual data from ORDA systems.
    - The thresholds are in Adaptation Data
  - SYSTEM NOISE TEMP DEGRADED – bad noise readings ($Noise_{current}$ or $Noise_{source)}$ or Noise Temp over 800
  - SYSTEM NOISE TEMP – MAINT REQUIRED – Noise Temp from 700-800
- Conditions
  - Elevation greater than 3.5° (prefer above 5°)
  - Clutter filter off
  - Point clutter filtering off
  - Interference suppression off
  - Transmitter off
  - **Noise test signal injected (Noise Source ON)**
  - Test attenuator set to 5dB attenuation
  - Front end injection point
  - Matched filter set to short pulse width
  - Successful Noise taken ($Noise_{current}$ available)
- Parameters

Table 5

Parameter	Number	Type	Description
$Noise_{source}$	R35	A	Excess Noise Ratio in dB from Noise Source
$Noise_{current}$			Short Pulse System Noise, measured Noise Power with no noise (“blue sky” noise). Note this calculation does not use the smoothed noise value.
NoiseScale(El)	R24-R36	A	The blue sky noise correction based on elevation (El).
$Noise_{ON}$			Measured Noise Power with Noise Source on
PL_{noise}			Path Losses from Noise Source to Front End
PL_A22J4_5	R60	A	Noise path through 4 Position Diode Switch

PL_A23J1_2	R63	A	Insertion loss of 7 bit Test Attenuator
PL_A24J1_2	R66	A	Front End path through 2 Position Diode Switch
PL_W53	R69	A	Cable from UD4 to Front End
PL_2A3J3	R72	A	Injection loss into Receiver Protector
PL_5dB	R119	A	5dB selected by 7 bit Test Attenuator
System Noise Temp Degrade Limit for Ctrl Chan	R227	A	
System Noise Temp Maint Limit for Ctrl Chan	R228	A	
System Noise Temp Degrade limit Non-Ctrl Chan	R229	A	
System Noise Temp Maint Limit Non-Ctrl Chan	R230	A	

PL – Path Loss

- Algorithm
  - $N_s = 512$ /* Number of Samples*/
  - El_{start} = current elevation
  - For i=1 to N_s /* gather 512 data points*/
    - Record I and Q values from receiver
    - $I\_Power = \frac{\left(\sum_{n=1}^{N_s} I_n^2\right)}{N_s}$
    - $Q\_Power = \frac{\left(\sum_{n=1}^{N_s} Q_n^2\right)}{N_s}$
  - El_{stop} = current elevation
  - $El = \frac{\left(El_{start} + El_{stop}\right)}{2}$
  - $Noise\_On = I\_Power + Q\_Power$
  - $\mathrm{PL_{noise}} = \mathrm{PL\_A22J4\_5 + PL\_A23J1\_2 + PL\_A24J1\_2 + PL\_W53 + PL\_2A3J3 + PL\_5dB}$ /* Compute Path Losses for noise injection into front end*/
  - If $Noise_{current}$ or $Noise_{ON} < 0$
    - $Noise_{Temp}=0$
    - Set Alarm SYSTEM NOISE TEMP DEGRADED
    - Return
  - $Noise_{Temp} = 290 * \left[\frac{10^{\left(Noise_{source}+PL_{noise}\right)/10}}{\left(Noise_{ON}/Noise_{current}\right) - 1}\right]$
  - Save $Noise_{Temp}$ in Performance Data
  - If $Noise_{Temp}>800$

        - Set Alarm SYSTEM NOISE TEMP DEGRADED
        - Return
    - ElseIF $Noise_{Temp}$>700
        - Set Alarm SYSTEM NOISE TEMP MAINT REQUIRED
        - Return
    - We're done.
-

Linearity

- Purpose
    - Receiver linearity and reflectivity calibration
- Description
    - This test replaces the RFD1,2,3 and CW tests for System Calibration. Instead, we run 10 points from the linear portion of the receiver transfer curve using CW test signals and check their fit to linear with a Least Squares Curve fit. Each calibration will use a different set of 10 points, and in 8 calibrations the entire linear range will be covered (thus probably testing the 7 bit Test Attenuator more than the receiver). The result of this line will be dBZ_0, the SIGMET equivalent to SYSCAL.
    - 10 points were chosen so we have enough points to preclude the possibility of a bad value skewing results, and to reduce the sensitivity of the Y_Intercept (and therefore I_0 and dBZ_0) to random changes in measurements or a bad measurement.
    - The most efficient way to use a least squares linear curve fit is to pick two widely spaced points, and gather several data points around each one (i.e. defining each point as accurately as possible), and curve fitting. Since the variance is inversely proportional to the distance of the x variables from the mean, this reduces the variance the most. We are not as concerned with the variance here, but we do need to verify how well all our data fits the entire curve. Therefore, our 10 points will be equally spaced through the linear region. This is not as efficient but gives us greater confidence in our transfer curve.
- Alarms
    - LINEARITY TEST SIGNAL MAINT REQUIRED - If 1 or 2 test points (out of 10) are more than 1dB from Linear – OR if deviation too great
    - LINEARITY TEST SIGNAL DEGRADED – if more than 3 test points are more than 1dB from Linear – OR if deviation really too great (the measure of how good the linear fit is)
    - LINEARITY SLOPE MAINT REQUIRED – if the calculated slope of the receiver curve varies more than 0.2
    - LINEARITY SLOPE DEGRADED – if the calculated slope of the receiver curve varies more than 0.1
    - CAL CONSTANT DEGRADED – when the measured dBZ_0 varies more than 2dB from the calibrated dBZ_0
- Conditions
    - Clutter filter off
    - Point clutter suppression off
    - Transmitter off
    - Interference suppression off
    - Front End injection point
    - CW Test Signals used (we need to correct for Matched Filter loss when using CW)
- Parameters

Table 6

Parameter	Number	Units	Type	Description
Atten		dB	A	Attenuation used for current measurement
PL		dB	A	Path Losses
CW Test Signal at A22J3	R34	dBm	A	CW Power from RF Generator
Test Signal Attenuator	R114 – R217	dB	A	103 steps of Test Attenuator

PL – A22J3_5	R59	dB	A	4 position diode switch
PL – A23J1_2	R63	dB	A	Test Attenuator insertion loss
PL – A24J1_2	R66	dB	A	2 Position switch to front end injection
PL – W53	R69	dB	A	Cable loss from receiver cabinet to receiver protector
PL – 2A3J3/2A7J3 Rcvr Protr Test Cplr	R72	dB	A	Receiver Protector coupler loss
PL – A24J1_3	R67	dB	A	2 Position switch to cabinet injection
PL – DC2	R80	dB	A	Cabinet Injection coupler loss
L_t		dB		Sum of Transmitter losses to the antenna
P_t		dBm	P	Peak Transmitter Power
τ	TR5	nsec	A	Short Pulse Transmitter Pulse Width
λ		cm		Transmit Wavelength
F	TR3	Mhz	A	Transmit Frequency
G	A1	dB	A	Antenna Gain
θ	A2	Degree	A	Antenna Beamwidth
c		m/sec		2.9979e08 m/sec speed of light

PL – Path Loss

-
- Algorithm
  - Constants
    - $PL_{cab} = R59 + R63 + R66 + R67 + R68$
    - $PL_{fe} = R59 + R63 + R66 + R69 + R72 + R73 + R74 + R77 + R78 + R79 + R80$
    - $PL_{shared} = R81 + R83 + R249 + R250$ */ R249 and R250 are new adaptation values
    - $L_t = TR17 + TR18 + TR19 + TR21 + TR22 + TR24 + TR25 + TR26 + TR27 + TR28 + TR29 + TR31$
    - $\lambda = {c}/{TR3} \times 10^{-4}$ */ λ in centimeters
  - Atten=5 /* Initialized to 5dB below 1dB compression point on the first calibration from startup, will not be 5dB attenuation set on 7 bit test attenuator */
  - For i=Atten to Atten-80, step –8 /* direction of attenuation doesn't matter */
    - Set attenuation to i /* use SIGMET Wrapper Library to set attenuation */
    - Turn on CW, Inject Signal
    - Injected_Power=CW_Power+PL+Atten
    - Wait 3 milliseconds to start collecting data /* it takes 3 ms for command and switching */
    - For j=1 to N_s /* N_s is number of samples, we'll assume 512 samples */
      - Get I_j and Q_j value
      - Calculate I_j^2 and Q_j^2 value
      - Store I_j^2 and Q_j^2 value
    - $\text{Lin\_Sample}_i = \left(Injected\_Power, 10\log\left(\frac{\sum_{j=1}^{N_s} I_j^2 + Q_j^2}{N_s}\right)\right)$ /* power values in dBm */
    - Store Lin_Sample_i
  - Atten=Atten-1 /* for next calibration sequence */
  - If Atten > 12 then Atten=5 /* creates 8 sets of 10 attenuation steps to run through the Linearity model */

- LEAST_SQUARES(Lin_Sample(a,b)) /* linear least squares calculation, returns slope and Y_Intercept */
- $I_0 = Slope * 10\log(2 \times Noise_{current}) + Y\_Intercept$ /* I_0 used to calculate dBZ_0
- $\mathrm{dBZ}_0 = 10\log(I_0) + 10\log(C) + L_t - P_t$ /* C - constants from radar equation and units conversion: $\dfrac{2.69e16 * \lambda^2}{\tau * \theta^2 * G^2}$, L_t in dB and P_t in dBm */
- Del_dBZ$_0$=dBZ$_0$_Adaptation-dBZ$_0$ /* Delta dBZ$_0$ for Performance Data
- Update Performance Data /* this may actually draw the curve and show the points */
- Check for Alarms

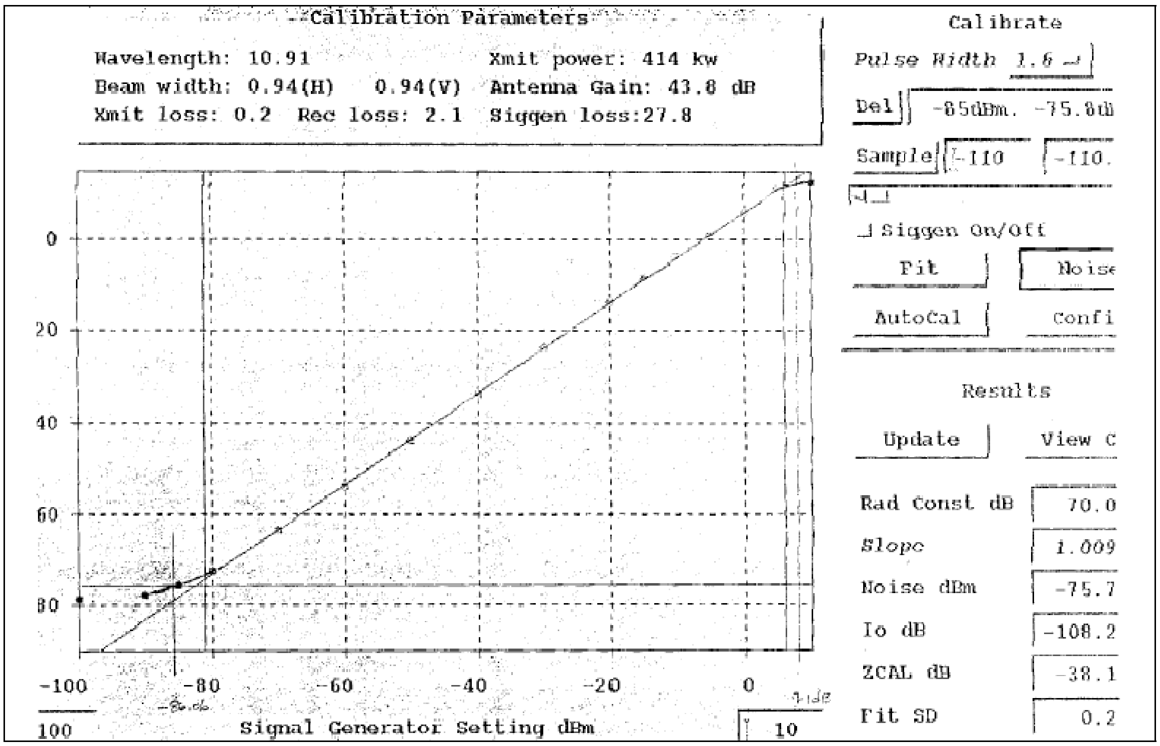

Figure 1

Dynamic Range

- Purpose
  - Test the receiver's dynamic range in short and long pulse from noise floor to 1dB compression point
- Description
  - Starting at an estimated 10dB below the 1dB compression with CW, step up 1dB at a time until we reach the 1dB compression point. Subtract the difference from the noise floor to get the dynamic range
- Alarms
  - DYNAMIC RANGE DEGRADED– Dynamic Range varies by more than 2dB from calibration
- Conditions
  - Clutter filter off
  - Point clutter suppression off
  - Transmitter off
  - Interference suppression off
  - Front End injection point
  - CW Test Signals used (we need to correct for Matched Filter loss when using CW)
  -

- Parameters

Table 7

Parameter	Number	Type	Description
CW	R34	A	CW Power from RF Generator
PL_{CW}	R59, R63, R66, R69, R72	A	Path loss for CW path to injection point
$L_{MatchedFilter}$	Rxxx	A	Detection loss from matched filter

  -
- Algorithm
  - $Atten = \dfrac{10\log(Noise_{current}) + 85 + Y\_Intercept}{Slope} - CW - PL_{CW} - L_{MatchedFilter}$ /* Start at 85dB above noise */
  - Use equation from linearity to determine the expected values for the next 10 1dB steps from $Noise_{current}$+85 and store them
  - Measure I and Q for the 10 1dB steps starting at Atten
  - Convert I and Q to power
  - Starting at Atten, look for where measured Power deviates from expected power by 1dB
  - That's the dynamic range number
  - Store it in Performance Data
  - Give alarm if it's too low

Spectrum Width/Velocity

- ***Difficulty: Cannot use CW and get burst pulse. Must fire transmitter to get burst pulse. Burst pulse gives us phase reference, so we cannot get valid Velocity/Spectrum Width without it.***
-
- ***Currently: This will only be done into the dummy load during the Performance Check. We will submit a waiver to the SS to do this instead of every VCP (due to architecture differences, reliability improvements, and historical failures).***
- Purpose
  - Use up processing cycles
- Description
  - This test tests the normal processing of the RVP8. We collect data for a set number of PRT's for a radial using known velocities and widths, and calculate V and W. We then compare them to the known velocities and widths, and generate alarms.
  - Test at the following Nyquist velocities using phase shifted CW:
    - 0
    - ¼ $V_{Nyquist}$
    - -3/8 $V_{Nyquist}$
    - 5/8 $V_{Nyquist}$
  - At each of the Nyquist velocities vary the phase with a dither to simulate Spectrum Width

  - We use a $V_{Nyquist}$ of 28 m/sec and a Spectrum Width of 4±2 m/sec (PRT varies from 1009 to 1121 depending on transmit frequency)
- Alarms
  - VELOCITY/SPECTRUM WIDTH CHECK DEGRADED – If one varies by more than limit set in Adaptation Data
  - VELOCITY/SPECTRUM WIDTH CHECK MAINT REQUIRED – If one varies by more than limit set in Adaptation Data but less than Degraded limit
- Conditions
  - Clutter filter off
  - Point clutter suppression off
  - Transmitter on
  - Interference suppression off
  - Front End injection point
  - CW Test Signals used
  - Phase Varied
- Parameters

Table 8

Parameter	Number	Type	Description

  -
- Algorithm
  - For Radial=1to4 /* 4 radials of data at different Velocities but all with the same Spectrum Width */
    - Velocity(Radial) ={0,1/4,-3/8,5/8} /* the 4 different Velocities we'll use stated as a percent of Nyquist
    - $PRF_{28m/sec} = (4 * 28)/\lambda$ /* to calculate the PRF needed for a $V_{Nyquist}$ of 28 m/sec, varies from 1009 for 2700MHz to 1121 for 3000MHz. This will be different for Long Pulse, since we can't fire the Tx at this PRF. */
    - For Pulse=1to32 /*32 pulses for each Velocity */
      - PhaseShift=(Velocity(Radial)*360*Pulse)mod 360 /* creates a phase shift for each pulse, monotonically increasing or decreasing to create a velocity */
      - PhaseShift=PhaseShift ±4 counts /* to add spectrum width,

Full Linearity

- Purpose
  - Test the entire receiver transfer curve
- Description
  - Using CW, run the entire range of the 103dB Test Attenuator from Noise Floor to receiver soft limit. Perform a Least Squares Curve Fit with a portion of the data (10-12 data points), then use the model to test the entire data list for linear fit. Use the curve fit data to test Noise, Linearity, and Dynamic Range.
- Alarms
  - Alarms from Linearity, Dynamic Range, and Noise tests
- Conditions
  - Clutter filter off

- Point clutter suppression off
- Transmitter off
- Interference suppression off
- Front End injection point for high level signals, Cabinet Injection point for low level signals
- CW Test Signals used
-

- Parameters

Table 9

Parameter	Number	Type	Description

-

- Algorithm
  - Select Cabinet Injection Point /* the Cabinet Injection Point has less gain allowing us to do the low level stuff */
  - Turn on CW
  - For i = 0 to 40
    - Atten = i – 103 /* attenuation from –103dB to –63dB, should be starting approximately 10dB below noise */
    - Select Attenuation
    - Wait 3ms
    - For n = 1 to N_s /* 512 samples taken*/
      - Get I and Q
      - $I\_Power_n = I_n^2$
      - $Q\_Power_n = Q_n^2$ /* Power levels */
    - $$Power_{lin1}(i) = 10\log\left(\frac{\sum_{n=1}^{N_s}\left(I\_Power_n + Q\_Power_n\right)}{N_s}\right)$$
  - Select Front End Injection Point /* the Front End Injection Point has more gain allowing us to cover the higher range */
  - For j = 10 to 90
    - Atten = j – 103 /* attenuation from –93dB to –13dB, which should put us 6dB or so into saturation and give us 10dB of overlap with Cabinet Injection*/
    - Select Attenuation
    - Wait 3ms
    - For n = 1 to N_s /* 512 samples taken*/
      - Get I and Q
      - $I\_Power_n = I_n^2$
      - $Q\_Power_n = Q_n^2$ /* Power levels */

- $$Power_{lin2}(j) = 10\log\left(\frac{\sum_{n=1}^{N_s}\left(I\_Power_n + Q\_Power_n\right)}{N_s}\right)$$
- /* We now have 2 arrays of power with 10dB of overlap */
- For overlapping region /* determine using PL's of Front End and Cabinet, along with difference in shared path */
  - Compare like terms
  - If Difference >1dB
    - Throw an alarm
  - Average terms and store
- Convert to a single array covering 110dB
- Pick 10 points from array in linear region
- Use Least Squares to compute y=mx+b
- Fill in expected curve array for 110dB
- Find low point where measured is 3dB greater than expected ((S+N)/N=2)
- This is Noise Level
- Find high point where measured is 1dB less than expected
- This is 1dB Compression point
- Subtract low from high to get Dynamic Range
- Compare the expected linear range to the measured linear range to see how close they are
- Throw alarms if things are awry /* awry criteria yet to be determined */

KD Check

- Purpose
  - Check the Klystron Pulse for amplitude, phase, and shape.
- Description
  - The KD Pulse is also used for Clutter Suppression, so this check will verify the pulse is good for use with Clutter Suppression. We'll turn on the transmitter, firing into dummy load, and measure this pulse. Like the RF Drive pulse, we need to be able to make sure we sample this pulse properly due to its short length. We'll inject this signal into the Front End, and then into the Cabinet to compare the two levels and help identify any problems with the Front End.
- Alarms
  - KD TEST SIG CHECK MAINT REQUIRED
  - KD TEST SIG CHECK DEGRADED
  - KD TEST SIG CHECK INJECTION MISMATCH – This is a problem with injecting into the front end and cabinet, typically would indicate a problem in the front end (possibly a receiver protector recovery problem, or passive diode limiter failure).
- Conditions
  - Transmitter On
  - Clutter Filter off
  - Point Clutter Suppression off
  - Interference Suppression off
  -
- Parameters

Table 10

Parameter	Number	Type	Description
KD_{Range}		A	Range in meters of KD pulse peak

  -
- Algorithm
  - 25m resolution
  - Park Antenna
  - Antenna to dummy load
  - KD test pulse selected, 0dB attenuation
  - Transmitter on, prf 1000
  - Front End Injection
    - Sample I and Q for KD_{Range}-200m to KD_{Range}+200m
    - Convert I and Q to power for each bin, correct for PL, save in array
    - Find start and stop of KD pulse (start at beginning of array, search for first value above noise, then start from end of array, find first value above noise)
    - Find range and power of KD pulse peak, store
    - Add all power of KD pulse from start to stop, store
  - Cabinet Injection
    - Sample I and Q for KD_{Range}-200m to KD_{Range}+200m
    - Convert I and Q to power for each bin, correct for PL, save in array
    - Find start and stop of KD pulse (start at beginning of array, search for first value above noise, then start from end of array, find first value above noise)
    - Find range and power of KD pulse peak, store
    - Add all power of KD pulse from start to stop, store
  - Compare Cabinet KD total power to Adaptation data, put in performance data and throw KD TEST SIG CHECK MAINT REQUIRED or KD TEST SIG CHECK DEGRADED
  - Compare Front End and Cabinet KD peak powers, put in performance data and throw KD TEST SIG CHECK INJECTION MISMATCH

Display pulse?

Clutter Suppression

- Purpose
  - Evaluate performance of clutter filter with a “perfect” clutter target, and establish upper bound of system phase noise
- Description
  - Using the delayed klystron pulse, measure it’s level with clutter filtering off and on. The difference is the reflectivity clutter suppression and the upper bound on system phase noise.
- Alarms
  - Same as legacy
- Conditions
  - Waveguide switch to dummy load
  - Antenna in park
  - Transmitter on
  - Transmitter warmed up for at least 8 seconds
  - Klystron Delayed pulse selected
  - 0dB test attenuation
  - No Interference detection
  - No Point Clutter Suppression
- Parameters

Table 11

Parameter	Number	Type	Description
KD_{Range}		A	Range of KD pulse, set to 25m resolution

- Algorithm
    - Set range resolution to 25m
    - Park Antenna
    - Switch waveguide to dummy load
    - Turn transmitter on
    - Select KD pulse, 0dB attenuation
    - Set KD_{Range} /* a new adaptation data, shows the range of the KD pulse within 25m */
    - 1 radial of 128 pulses, PRT 1000
    - Clutter Filter off
    - Get I and Q power of KD Pulse at KD_{Range}-25m, KD_{Range}, and KD_{Range}+25m, take the maximum /* This is to find the exact pulse center and use that. The KD Check gives us the approximate center */
    - Save power
    - 1 radial of 128 pulses, PRT 1000
    - Clutter filter on
    - Get I and Q power of KD Pulse at KD_{Range}-25m, KD_{Range}, and KD_{Range}+25m, take the maximum
    - Save power
    - $Power_{filterOff}$-$Power_{FilterOn}$ = Clutter_Suppression
    - Throw alarms
    - Save in performance data

RFD Check

- Purpose
    - Check the RF Drive Pulse for amplitude/phase
- Description
    - With the transmitter off, generate RF Drive test pulses and measure them. We need to use a very narrow range (i.e. 25m instead of 250m) to ensure we get the center of the pulse since we can't vary the sample timing
- Alarms
- Conditions
- Parameters

Table 12

Parameter	Number	Type	Description

- Algorithm
  - Turn on RFD’s
    - Will probably define a new “pulse width” in SIGMET to get a new trigger sequence
  - Find Center of Pulse
    - Use 25m resolution and look for it
  - Calculate RFD magnitude
  - Calculate RFD phase
  - Calculate Phase Jitter